

# Assessment of Differences Between the Modified Cincinnati and International Knee Documentation Committee Patient Outcome Scores

## A Prospective Study

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**Background:** Functional outcome questionnaires have become a common part of patient follow-up in the orthopaedic community. The modified Cincinnati Knee Rating System and the International Knee Documentation Committee (IKDC) subjective scale were designed to provide clinicians with information regarding a patient's functional and clinical status after knee surgery.

**Hypothesis:** The functional outcome data reported on the modified Cincinnati Knee Rating System and the IKDC subjective questionnaire are equivalent.

**Study Design:** Cohort study (diagnosis); Level of evidence, 2.

**Methods:** Between 2000 and 2007, all patients with complex knee disorders seen in our orthopaedic clinic were prospectively followed and given simultaneously the modified Cincinnati Knee Rating System and the IKDC subjective questionnaires to report their functional outcomes. The total scores of each instrument were compared at each time of evaluation. As a measure of responsiveness, the standardized response means were calculated. A second within-patient analysis was also performed to determine if the results would be different when looked at by the patient.

**Results:** There were a total of 130 patients with a total of 444 modified Cincinnati Knee Rating System questionnaires and 462 IKDC subjective complete questionnaires included in the study. Overall total scores on both the modified Cincinnati Knee Rating System and the IKDC subjective questionnaires were equivalent in a population analysis. Overall total scores showed improvement in function over time from preoperative measurement through the 2-year follow-up. The individual patient analysis demonstrated that, for a specific patient, it was possible that up to 34% of the population would report a total score of more than 10 points difference, depending on the scale selected.

**Conclusion:** The modified Cincinnati Knee Rating System and the IKDC subjective rating questionnaires reported by patient population provide similar results. The practitioner who is not performing a population-based study but following individual patients for recovery will find that the individual questionnaires may offer different functional limitations. Individual differences were lost in the population means, with the approximate balance of positive and negative score differences masking the individual patient differences.

**Keywords:** modified Cincinnati Knee Rating System questionnaire; International Knee Documentation Committee (IKDC) subjective questionnaire; complex knee disorders; outcome scores

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questionnaire was created in the early 1960s, the development of these instruments has proliferated throughout the community.<sup>1,21</sup> Some questionnaires were designed to cover a patient's overall health status (generic questionnaires),<sup>19</sup> while others focused on specific anatomic areas or treatments (disease-specific).<sup>11,18</sup>

In the sports medicine community, one of the more commonly used questionnaires is the Cincinnati Knee Rating System, which was developed in 1983.<sup>12-14</sup> The original form of the Cincinnati Knee Rating System has multiple parts: symptoms, sports activity, and activities of daily living scales, along with clinical parameters. This rating system was modified over the years to a version that requires patient input only and provides the user with an overall score as well as symptom and functional subscores. The origin of this modification has proven elusive and is not endorsed by the original developers, but the authors of this article believe this version (see online Appendix 1 for this article at <http://ajs.sagepub.com/supplemental/>) is the one often used in presentations and in the literature.<sup>2,16,17,20</sup> The modified Cincinnati Knee Rating System scores range from 6 to 100 (best function).

In 2000, the International Knee Documentation Committee (IKDC) developed the IKDC subjective outcome scale (see online Appendix 2 for this article at <http://ajs.sagepub.com/supplemental/>). This instrument was developed to address what a group of clinicians thought was a need for a simple form that would allow for evaluation of knee treatments.<sup>5</sup> The IKDC subjective scale provides the user with an overall function score. This instrument has been subjected to rigorous statistical evaluation and has proven to be a reliable, valid, and responsive outcome measurement tool.<sup>6</sup> The IKDC scores range from 0 to 100, with 100 indicating no limitation in patient function.

When given a score after completing a questionnaire, both patients and clinicians often make a mental interpretation as to what the score means in terms of their personal recovery. As we move toward our goal of having a better understanding of what the scored results actually mean and how they can be used to determine appropriate treatment and assess recovery, the purpose of our study was to assess the information scored by patients at the same time intervals for the modified Cincinnati Knee Rating System and IKDC subjective questionnaires to determine if the results indicated equivalent functional limitations. Our hypothesis was that the functional outcome data reported on the modified Cincinnati Knee Rating System and the IKDC subjective questionnaires provided clinicians with equivalent scores representative of equivalent functional status. Our aim was to determine if one could perhaps cease administration of 1 of the 2 subjective scoring questionnaires because they would prove to provide scores that were equal in magnitude, and thus could be considered to provide equivalent information.

## METHODS

Starting in 2000, as part of routine clinical patient care, all patients with complex knee disorders seen in our orthopaedic

clinic were prospectively followed and given simultaneously the modified Cincinnati Knee Rating System and the IKDC subjective questionnaires to report on their functional outcomes. These questionnaires were administered preoperatively in the clinic, with the patient alone in an examination room, at 6 months after surgical treatment, and thereafter on an annual basis. The complex knee disorders followed included proximal tibial opening wedge osteotomies, meniscal transplants, refrigerated osteoarticular allografts, and multiple ligament knee reconstructions.

Both questionnaires were given to our patients because when this protocol of patient care was instituted, the IKDC subjective form was just coming into use. Therefore, we believed it was important to administer both outcome measurement tools to have the ability to compare our results with those in the literature as well as follow individual patients' recoveries. We did not control for the order in which the patients completed these 2 questionnaires, although the modified Cincinnati Knee Rating System was always on the top of the paperwork provided to the patient.

To determine if the responses we received demonstrated equivalent scores that were representative of equivalent functional limitations, the total scores on both instruments were examined by time intervals of initial evaluation (pre-operatively), 4 to 8 months, 9 to 15 months, 16 to 24 months, and more than 24 months. Selected subsection item responses were evaluated for those questions that were approximately the same in the 2 subjective scoring instruments. Several questions were thought to be sufficiently similar to allow for direct-response comparison between the 2 questionnaires. We analyzed the responses to the 3 questions related to swelling in the presence of activity, giving way in the presence of activity, and overall activity level. When the item responses available to the patient were not the same, only the extremes (highest and lowest function) were compared between the scoring subsections. The specific questions used are highlighted in the questionnaires (Appendices 1 and 2).

As a measure of responsiveness, the standardized response means (SRMs) were calculated by dividing the change score (follow-up minus previous interval) by the standard deviation of the change score.<sup>4</sup> Pearson product correlations were calculated to compare the 2 questionnaires as a measure of construct validity. Additional analyses were performed to compare the results by sex and age categories (ages  $\leq 29$ , 30-43, 44-59, and  $\geq 60$  years).<sup>3</sup>

Data were analyzed initially by population because all results in the literature report functional outcome scores for the population and not the individual patient. To determine if the population analysis was masking individual patient differences on the questionnaires, a second within-patient analysis was also performed to determine if the results would be different when looked at by the individual patient.<sup>15</sup> The IKDC subjective score was subtracted from the modified Cincinnati Knee Rating System score to create a difference score.

Descriptive statistics and Student *t* tests were used, with all analyses performed using SPSS version 14 software (SPSS Science Inc, Chicago, Illinois). Normalcy of the data

at each time interval was verified by Kolmogorov-Smirnov testing. Statistical significance was assessed by  $P < .05$ .

This project was completed under institutional review board approval with informed consent from all patients, all of whom had to be able to read English and who were judged capable of completing the questionnaires. The data were gathered as part of a functional outcome study looking at long-term surgical results of our population.

## RESULTS

One hundred thirty patients had a total of 490 administrations of each of the 2 questionnaires. Missing responses in portions of the scoring sheets, which limited the complete scoring of some questionnaires, resulted in a total of 444 modified Cincinnati Knee Rating System questionnaires and 462 IKDC subjective questionnaires for these 130 patients. Six was the highest number of administrations of a questionnaire to any given patient. The average age of these patients at the time of surgery was 31 years (range, 14-62 years).

### Group Analysis

The questionnaires were evaluated at different time intervals to ensure that there was no difference in comparability over time. Overall, the scores on both questionnaires showed equivalent functional limitations equal to 43.3 (modified Cincinnati Knee Rating System) and 45.0 (IKDC subjective) at baseline with improvement to 60.9 at 2 years (Table 1). At no time interval was there more than a 3-point difference between the modified Cincinnati Knee Rating System and IKDC subjective scores. This 3-point difference in scores was significantly different at baseline, with the IKDC subjective score being higher ( $P = .013$ ), and at more than 2 years, with the modified Cincinnati Knee Rating System score being higher ( $P = .039$ ).

In addition, there was no demonstrable difference in the ceiling and floor effects. Scores of 46 patients from the modified Cincinnati Knee Rating System and 51 patients from the IKDC subjective questionnaires were in the top 10% of scores. Scores of 43 patients from the modified Cincinnati Knee Rating System and 47 patients from the IKDC subjective questionnaires were reported in the bottom 10% of scores.

When measuring swelling (effusions), the modified Cincinnati Knee Rating System scoring system has a 7-item scaled response and the IKDC subjective questionnaire has a 5-item scaled response (Appendices 1 and 2). Comparing the combined first 2 responses on the modified Cincinnati Knee Rating System instrument, which includes responses of no swelling and occasional swelling with strenuous sports or heavy work, with the IKDC subjective questionnaire first 2 items of no or minimal swelling with very strenuous activities and strenuous activity, 71 of 165 responses (43%) were equivalent. Ninety-four of the 165 patients (57%) endorsing responses on the modified Cincinnati Knee Rating System instrument of either

TABLE 1

Average Modified Cincinnati Knee Rating System and International Knee Documentation Committee (IKDC) Subjective Patient Scores by Preoperative and Postoperative Time Intervals

System	N	Mean	95% Confidence Interval for Mean		Minimum	Maximum
			for Mean	Interval		
<b>Cincinnati</b>						
Preoperative	246	43.3	40.5	46.1	6	92
4-8 mo	73	55.7	49.8	61.6	12	96
9-15 mo	56	60.4	53.0	67.8	11	100
16-24 mo	15	67.4	54.5	80.3	29	100
>24 mo	54	60.9	53.5	68.3	8	100
All patients	444	50.4	48.1	52.8	6	100
<b>IKDC</b>						
Preoperative	247	45.0	42.6	47.4	1.3	98.9
4-8 mo	85	58.1	51.6	60.5	11.5	94.3
9-15 mo	57	62.5	56.2	58.7	3.4	100
16-24 mo	18	64.7	54.3	75.2	28.7	97.7
>24 mo	55	60.9	53.9	67.8	6.9	100
All patients	462	51.9	49.8	53.9	1.3	100

no swelling or occasional swelling with strenuous sports or heavy work chose responses indicating greater limitations as the result of swelling on the responses on the IKDC subjective form. One hundred twenty-four of 134 patients (93%) who endorsed the highest levels of disability related to swelling on the modified Cincinnati Knee Rating System instrument also chose either "unable to perform" or "significant swelling" with more than light activity like walking, housework, or yard work on the IKDC subjective form.

When measuring their overall activity level, the modified Cincinnati Knee Rating System scoring system has a 7-item scaled response and the IKDC subjective questionnaire ("What is the highest level of activity you can participate in on a regular basis?") has a 5-item scaled response (Appendices 1 and 2). Combining the first 2 responses on the modified Cincinnati Knee Rating System instrument, which includes no limitations and able to sustain vigorous sport performance, compared with the IKDC subjective first 2 items of being able to participate in very strenuous or strenuous activities, 55 of 83 responses (66%) were equivalent. Twenty-eight of the 83 patients (34%) who had chosen responses one or two on the modified Cincinnati Knee Rating System scoring system chose responses indicating greater limitations in activity in the equivalent choices on the IKDC subjective scale. The wording of the item responses on the activity level at the lowest level of functional ability was sufficiently different to make comparison invalid between the 2 scoring systems for the patients who reported lowest overall activity level (Appendices 1 and 2).

When measuring giving way, the modified Cincinnati Knee Rating System scoring system has a 7-item scaled response and the IKDC subjective questionnaire ("What

**TABLE 2**  
Standardized Response Means of the Cincinnati Knee Rating System and International Knee Documentation Committee (IKDC) Between Adjacent Time Intervals

Standardized Response Mean	Preoperative to 4-8 mo	4-8 to 9-15 mo	9-15 to 16-24 mo	16-24 to >24 mo
Cincinnati	-3.8	-0.9	-0.99	0.92
IKDC	-4.4	-1.7	-0.37	0.63

**TABLE 3**  
Pearson Correlation Coefficient

	Preoperative	4-8 mo	9-15 mo	16-24 mo	>24 mo
Cincinnati vs IKDC <sup>a</sup>	0.87	0.92	0.92	0.946	0.883
P values	.001	.001	.001	.001	.001

<sup>a</sup>IKDC, International Knee Documentation Committee.

is the highest level of activity you can perform without significant giving way in your knee?") has a 5-item scaled response. Combining the first 2 responses on the modified Cincinnati Knee Rating System instrument, which includes no giving way and occasional giving way with strenuous sports and heavy work, compared with the IKDC subjective scoring of the first 2 items of very strenuous or strenuous activities causing giving way, 69 of 123 responses (56%) were equivalent. Forty-four of 123 responses (36%) on the modified Cincinnati Knee Rating System scoring system were by patients who identified greater limitations on the IKDC subjective form for evaluation of giving way. The wording of the item responses on the giving way questions at the higher level of disability was sufficiently different to make comparison invalid between the 2 scoring systems for evaluation of severe giving way episodes (Appendices 1 and 2).

Table 2 demonstrates the SRM to be highest between the initial and 4 to 8 months of follow-up for both questionnaires. Over time, the modified Cincinnati Knee Rating System questionnaire demonstrated an SRM around 0.9 and the IKDC subjective form varied from 0.37 to 1.7.<sup>6,8,9</sup>

Table 3 demonstrates highly significant correlations between the 2 questionnaires ( $P < .001$ ) at each of the study time intervals. Sex differences in both the Cincinnati Knee Rating System and IKDC were found (Table 4) at baseline and the 16 to 24 months time interval.

At baseline, within each questionnaire, significant differences using 1-way analysis of variance (ANOVA) with least square difference (LSD) post hoc testing across age categories were present (Cincinnati Knee Rating System:  $F = 6.6, P < .01$ ; IKDC:  $F = 5.7, P < .01$ ). The Cincinnati Knee Rating System scale showed differences between ages 29 years and younger versus ages 30 to 43, 44 to 59, and 60 years and older. For the IDKC scale, significant differences were found between ages 29 years and younger and 30 to 43 years, and 29 years and younger and 44 to 59 years (Table 5).

**TABLE 4**  
Mean Cincinnati Knee Rating System and International Knee Documentation Committee (IKDC) Scores by Sex at Various Time Intervals

	Preoperative (SD)	4-8 mo (SD)	9-15 mo (SD)	16-24 mo (SD)	>24 mo (SD)
Cincinnati					
Male	46.5 <sup>a</sup> (22.7)	55.8 (26.6)	61.4 (29.3)	82.6 <sup>b</sup> (13.5)	62.8 (27.2)
Female	35.6 <sup>a</sup> (19.5)	55.5 (21.5)	57.6 (22.8)	54.1 <sup>b</sup> (22.4)	55.0 (27.1)
IKDC					
Male	47.7 <sup>a</sup> (19.2)	56.4 (22.4)	62.9 (25.4)	74.9 <sup>c</sup> (16.8)	62.0 (25.8)
Female	38.7 <sup>a</sup> (17.3)	55.4 (15.7)	61.3 (18.4)	52.0 <sup>c</sup> (19.5)	57.2 (26.2)

<sup>a</sup> $P < .001$  (preoperative, Cincinnati and IKDC).

<sup>b</sup> $P = .01$  (16-24 mo, Cincinnati).

<sup>c</sup> $P = .02$  (16-24 mo, IKDC).

At 4 to 8 months, within each questionnaire, there were significant differences using 1-way ANOVA with LSD post hoc testing across age categories (Cincinnati Knee Rating System:  $F = 8.3, P < .01$ ; IKDC:  $F = 6.6, P < .01$ ). Differences across the age groups were unable to be calculated because of the small sample sizes in some of the cells (Table 5).

At 9 to 15 months, within each questionnaire, there were significant differences using 1-way ANOVA with LSD post hoc testing across age categories (Cincinnati Knee Rating System:  $F = 5.5, P < .002$ ; IKDC:  $F < 3.5, P = .02$ ). Differences across the age groups were unable to be calculated for the Cincinnati Knee Rating System because of the small sample sizes in some of the cells. For the IDKC scale, significant differences were found only between ages 29 years and younger and ages 30 to 43 years (Table 5).

At 16 to 24 months, within each questionnaire, there were significant differences using 1-way ANOVA with LSD post hoc testing across age categories in the Cincinnati Knee Rating System only (Cincinnati Knee Rating System:  $F = 8.3, P = .01$ ; IKDC:  $F = 3.5, P = .06$ ). Differences across the age groups were unable to be calculated for the Cincinnati Knee Rating System because of the small sample sizes in some of the cells. For the IKDC scale, significant differences were found only between ages 29 years and younger and age 30 to 43 years (Table 5). At more than 24 months, within each questionnaire, there were no statistically significant differences using 1-way ANOVA with LSD post hoc testing across age categories (Table 5).

#### Individual Patient Analysis

When individual patient results were evaluated, the differences between the 2 instruments were more pronounced. At the preoperative time interval, the difference in scores between the modified Cincinnati Knee Rating System and the IKDC subjective form ranged from -30.0 to 28.4. At the 4 to 8 months interval, the individual patient differences

**TABLE 5**  
Cincinnati Knee Rating System  
and International Knee Documentation  
Committee (IKDC) Age Scores by Interval

Age (y)	Preoperative	4-8 mo	9-15 mo	16-24 mo	>24 mo
	Mean	Mean	Mean	Mean	Mean
	SD	SD	SD	SD	SD
Cincinnati					
≥29	48.4	67.9	71.7	78.9	63.4
	22.0	22.4	23.5	16.4	24.0
	136	38	30	9	22
30-43	38.3	43.1	44.4	50.2	56.4
	20.9	20.3	25.2	22.4	26.6
	87	26	21	6	27
44-59	33.6	43.3	53.5	—	93.1
	22.8	26.3	33.5		0.0
	20	8	4		1
≥60	19.3	22.0	87.0	—	—
	12.7	0.0	0.0		
	3	1	1		
IKDC					
≥29	49.2	63.5	70.1	71.7	60.3
	18.5	18.5	23.3	17.6	25.0
	137	49	32	10	22
30-43	40.5	45.4	50.6	48.7	59.4
	18.2	18.3	19.1	21.7	28.2
	88	27	19	6	27
44-59	37.9	50.5	52.3	77.9	67.0
	19.9	22.6	25.7	0.3	37.4
	19	8	4	2	4
≥60	29.9	25.3	73.5	—	90.0
	19.9	0.0	26.1		0.0
	3	1	2		1

in scores ranged from -32.6 to 18.6. At the 9 to 15 months interval, the score differences ranged from -55.1 to 17.9. At the 9 to 15 months interval, the score -55.1 was an outlier, with the next closest score difference being -22.0. At the 16 to 24 months interval, the range score difference was -9.5 to 23.2, and after 24 months the score difference range was -29.2 to 66.8. In the after 24 months interval, 66.8 was an outlier, with 15.9 being the next score. Table 6 demonstrates that, across time intervals, between 9% and 21% of the population exhibited individual patient score differences of more than 10 points.

## DISCUSSION

When looked at by overall score in the patient population, we found that the modified Cincinnati Knee Rating System scoring system and the IKDC subjective form provide the user with equivalent amounts of overall patient functional limitations. The way that outcome scores are commonly reported in the literature—by population means—a clinical difference at baseline between 43.2 (modified Cincinnati Knee Rating System) and 45.0 (IKDC subjective) is likely

**TABLE 6**  
Individual Patient Score Differences  
More Than 10 Points<sup>a</sup>

Time Interval	Negative Score (%)	Positive Score (%)
Preoperative (n = 244)	21	13.5
4-8 mo (n = 70)	15.7	12.9
9-15 mo (n = 53)	15.1	9.4
16-24 mo (n = 15)	0	6.7
>24 mo (n = 53)	18.9	15.1

<sup>a</sup>Negative score indicates higher International Knee Documentation Committee objective score; % is percentage of patients.

to be meaningless in terms of demonstrable patient functional limitation. Our 2-year scores were also very similar (67.4 for the modified Cincinnati Knee Rating System and 64.7 for the IKDC subjective scale). The IKDC defines no improvement in function as less than an 11.5-point change in score, making it likely that our demonstrated difference of 2.7 points would not be clinically important. However, when individual item responses were reviewed, it appeared that patients reported varying levels of functional limitations. This finding highlights the need for clinicians to carefully review the contents of the instrument they are planning to administer and determine if the questions and their wording, along with the responses, are appropriate for their given population. Both instruments demonstrated an improvement in patient function through the 2-year mark. Both instruments then showed a small decline in patient-reported function after 2 years. This decline highlights the importance of following patients for periods greater than 2 years, even if they require no further surgical interventions, because their function may deteriorate over time. It is also possible that the deteriorating function over time identified here is simply a result of aging and its resultant decrease in function.

The individual patient analysis demonstrated that, for a specific patient, it was possible that up to 34% of the population would report a total score of more than 10 points difference, depending on the scale selected. Individual differences were lost in the population means, with the approximate balance of positive and negative score differences masking the individual patient differences.

The modified Cincinnati Knee Rating System scoring form and the IKDC subjective questionnaire appear to give equivalent results for overall patient function in populations. However, a thorough reading of the questionnaires is valuable before choosing and implementing one for any specific research project as there may be certain questions or responses that provide a more applicable range of choices to a given population. As an example, the questions pertaining to kneecap grinding are not relevant to patients with instability, while the questions on giving way are most relevant to patients with instability complaints. It is also important to consider that the majority of these patients underwent major knee reconstructive surgery, and these results may be different for patients undergoing smaller operations or who are treated nonoperatively.

As clinicians, we do not have a good understanding on either of these questionnaires of the relationship between a score of 65 and the patient's clinical examination and physical activity level; however, it appears that, between these questionnaires, the total scores are interchangeable when reporting by population. However, when individual questions that purport to measure the same activity or symptom are assessed, the equivalent level of ability or degree of symptoms is not always reported by the patient on the 2 different scoring systems. This may be due to subtle differences in the wording of the item of the questionnaire or the more specific choices in some of the responses, and result in the within-patient differences seen in this study.

Standardized response means demonstrated acceptable responsiveness at the different time intervals when compared with other instruments. In a study by Marx et al,<sup>10</sup> a longer version of the Cincinnati Knee Rating System demonstrated an SRM of 0.8 and the Lysholm scale was 0.9. Kirkley et al<sup>7</sup> demonstrated SRMs ranging from 0.366 for the Short Form-12 physical score to 0.931 for the Western Ontario Shoulder Instability Index. In an evaluation of the IKDC subjective form, Irrgang et al<sup>6</sup> reported an SRM of 0.94. Our SRMs are higher than those reported in the literature, potentially because of the time intervals used, which were different from the literature and were all considered moderate to large according to Liang et al.<sup>9</sup>

The differences found between the sexes and across the ages at the various time intervals should remind the user to keep those factors in mind when interpreting functional status of a patient. If women consistently report lower functional status than men, population analysis may be masking differences in treatment responses or recovery time. This would also be true for various age groups, although our populations by age category were too small to make definitive conclusions about the differences. Clinicians who report functional status should be encouraged to report their results by sex and age groups so that potential differences can be better understood.

A limitation of this study was that the Cincinnati Knee Rating System requests that patients respond based on "at time of completion" of the questionnaire, whereas the IKDC form requests the response to be "within the last 4 weeks." This could cause the patient who carefully reads the instructions to provide different gradients of answers to the same questions. It is possible that by combining responses in the individual item analysis, we masked some of the detail of a patient's response. Another limitation of this study was that it was a subset of a larger population outcome study and the data were not collected specifically for this one purpose.

In conclusion, we found that the 2 self-administered, patient functional outcomes instruments evaluated in this study, the modified Cincinnati Knee Rating System scoring system and the IKDC subjective questionnaire, provided similar results on a scale of 0 to 100 when looked at by total overall score using the population means. When deciding which questionnaire to use, the importance of determining what one is going to do with the data and what one hopes to measure cannot be overemphasized. Population

studies may provide different results from individual patient analysis. One questionnaire may contain a group of questions that are more relevant to a specific diagnosis. One questionnaire may be more general, allowing for comparisons across broader groups. The choosing of an instrument to measure functional status should not be taken lightly but rather should be made in the context of the patient population for which it was designed, is to be used, and what one intends to do with the results. When evaluated on a patient comparison level, there was a much larger variation in overall score, with approximately 14% of the patients reporting a lower modified Cincinnati Knee Rating System score and 12% of the patients reporting a lower IKDC subjective score.

## REFERENCES

1. Agel J, Swiontowski M. Guide to outcomes instruments for musculoskeletal trauma research. *J Orthop Trauma*. 2006;20(8 Suppl):S1-S146.
2. Arthur A, LaPrade RF, Agel J. Proximal tibial opening wedge osteotomy as the initial treatment for chronic posterolateral corner deficiency in the varus knee: a prospective clinical study. *Am J Sports Med*. 2007;35:1844-1850.
3. Barei DP, Agel J, Swiontowski MF. Current utilization, interpretation, and recommendations: the musculoskeletal function assessments (MFA/SMFA). *J Orthop Trauma*. 2007;21:738-742.
4. Brozek JL, Guyatt GH, Heels-Ansdell D, et al. Specific HRQL instruments and symptom scores were more responsive than preference-based generic instruments in patients with GERD. *J Clin Epidemiol*. 2009;62(1):102-110.
5. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the International Knee Documentation Committee Subjective Knee Form. *Am J Sports Med*. 2001;29:600-613.
6. Irrgang JJ, Anderson AF, Boland AL, et al. International Knee Documentation Committee: responsiveness of the International Knee Documentation Committee subject knee form. *Am J Sports Med*. 2006;34:1567-1573.
7. Kirkley A, Griffin S, McLintock H, Ng L. The development and evaluation of a disease-specific quality of life measurement tool for shoulder instability: the Western Ontario Shoulder Instability Index (WOSI). *Am J Sports Med*. 1998;26:764-772.
8. L'Insalata JC, Warren RF, Cohen SB, Altchek DW, Peterson MG. A self-administered questionnaire for assessment of symptoms and function of the shoulder. *J Bone Joint Surg Am*. 1997;79:738-748.
9. Liang MH, Fossel AH, Larson MG. Comparisons of five health status instruments for orthopedic evaluation. *Med Care*. 1990;28:632-642.
10. Marx RG, Jones EC, Allen AA, et al. Reliability, validity, and responsiveness of four knee outcome scales for athletic patients. *J Bone Joint Surg Am*. 2001;83:1459-1469.
11. Mohtadi N. Development and validation of the quality of life outcome measure (questionnaire) for chronic anterior cruciate ligament deficiency. *Am J Sports Med*. 1998;26:350-359.
12. Noyes FR, ed. *The Cincinnati Knee Rating System*. Cincinnati, OH: Cincinnati SportsMedicine Research and Education Foundation; 1983.
13. Noyes FR, Matthews DS, Mooar P, Grood E. The symptomatic anterior cruciate-deficient knee. Part II: the results of rehabilitation, activity modification, and counseling on functional disability. *J Bone Joint Surg Am*. 1983;65:163-174.
14. Noyes FR, Mooar P, Matthews DS, Butler DE. The symptomatic anterior cruciate-deficient knee. Part I: the long-term functional disability in athletically active individuals. *J Bone Joint Surg Am*. 1983;65:154-162.
15. Paradowski PT, Englund M, Roos EM, Lohmander LS. Similar group mean scores, but large individual variations, in patient-relevant outcomes over 2 years in meniscectomized subjects with and without radiographic knee osteoarthritis. *Health Qual Life Outcomes*. 2004;2:38.

16. Risberg MA, Holm I, Myklebust G, Engebretsen L. Neuromuscular training versus strength training during first 6 months after anterior cruciate ligament reconstruction: a randomized clinical trial. *Phys Ther.* 2007;87:737-750.
17. Risberg MA, Holm I, Tjomsland O, Ljunggren E, Ekeland A. Prospective study of changes in impairments and disabilities after anterior cruciate ligament reconstruction. *J Orthop Sports Phys Ther.* 1999;29:400-412.
18. Roos EM, Roos HP, Ekdahl C, Lohmander LS. Knee injury and osteoarthritis outcome score (KOOS): validation of a Swedish version. *Scand J Med Sci Sports.* 1998;8:439-448.
19. Shapiro ET, Richmond JC, Rockett SE, McGrath MM, Donaldson WR. The use of a generic, patient-based health assessment (SF-36) for evaluation of patients with anterior cruciate ligament injuries. *Am J Sports Med.* 1996;24:196-200.
20. Siebold R, Buelow JU, Bos L, Ellermann A. Primary ACL reconstruction with fresh-frozen patellar versus Achilles tendon allografts. *Arch Orthop Trauma Surg.* 2003;123:180-185.
21. Suh M, Hanson BP, Norvell DC, Helfet DL. *AO Handbook of Musculoskeletal Outcomes Measures and Instruments.* New York: Thieme Medical Publishers; 2005.

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